HYDROCYANIC ACID IN PLANTS.

Part iii.

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Some new cyanogenetic Plants.

The names of the plants included in this paper are additional to those tabulated in Parts i. and ii. of this subject (see these Proceedings, xxxvii., 1912, 220; and xxxviii., 1913, 624).

The following plants gave positive reactions for hydrocyanic acid when tested with sodium picrate paper in chloroform vapour; and the reactions were afterwards confirmed by the prussian blue test.

(Native) *Alocasia macrorrhiza* Schott.
Cardamine dictyosperma Hook.
Dysphania littoralis R.Br.*
Juncus prismatocarpus R.Br.
Heterodendron oleæfolia Desf.

(Introd.) *Alocasia macrorrhiza* var. *variegata* (Nich., Dict. of Gard.).
Alocasia augustiana Lindl. and Rod.
Alocasia Sanderiana (Bailey's Cyclop. of Amer. Hort.).
Alocasia intermedia (sp. unconfirmed).
Alocasia spectabilis (sp. unconfirmed).
Passiflora alba Link and Otto.
Tacsonia mixta Juss.

The following is a brief account of some experiments on the Alocasias:—

* Smith and White, of Brisbane, obtained hydrocyanic acid from *D. myriocephala* Benth., which is probably the same plant (Queensl. Agric. Gaz., 1915, 264).

(1.) *Alocasia macrorrhiza* Schott, (Prod. Syst. Aroid., 1860, 146) Index Kew., the "cunjevoi" of the aborigines. Specimens of plants, growing wild in the bush, and cultivated in private gardens, were tested for hydrocyanic acid. In all the fresh leaves, the colour-change with picrate paper was observed to take place within a few seconds. When the newly-cut leaves were placed in a bottle without any reagent, the test-papers quickly changed colour.

Leaves which had become yellow and completely withered still showed the reaction.

Distribution in the plant:—The various parts and organs of this plant were next examined separately. Uniform conditions were observed throughout, as to quantity of material, size of bottle, temperature, etc., and the time noted after which the colour-change in the picrate paper was observed.

Parts of one plant tested:—

1. Leaves	Red in 1-5 minutes
2. Leaf-stalks	Orange in 3 hours.
3. Bulb at base	Pale orange in 3 hours.
4. Rhizome	Negative after 24 hours.
5. Roots	Red in 5 minutes.

Stalks alone tested:—

1. Midrib at tip	Red in 1 hour.
2. Midrib at middle	Orange in 1 hour.
3. Midrib at base	Pale orange in 1 hour.
4. Stalk at middle	Negative after 12 hours.
5. Stalk at base	Negative after 12 hours.

Distribution in one plant, from summit to base:—

1. Leaves	Red in 5 minutes, dark red in 3 days.
2. Green spathe	Red in 1 hour, dark red in 3 days.
3. Ovary	Red in 1 hour, dark red in 3 days.
4. Seeds	Red in 1 hour, dark red in 3 days.
5. Leaf-stalk, top	Orange in 1 hour, dark red in 3 days.
6. ,, lower	Orange in 1 hour, dark red in 3 days.
7. ,, ,,	Orange in 5 minutes, dark red in 3 days.
8. ,, ,,	Red in 5 minutes, dark red in 3 days.
9. ,, ,,	Red in 5 minutes, dark red in 3 days.
10. ,, base	Red in 5 minutes, dark red in 3 days.

11. Bulb, pink cone	Orange in 1 hour, orange in 3 days.
12. Rhizome	Negative after 3 days.
13. ,,	Negative after 3 days.
14. ,, next roots	Negative after 3 days.
15. Roots	Red in 1 hour, dark red in 3 days.

The glucoside disappears on exposure to air:—When fresh green leaves were exposed by being spread out openly on the table, and tested at intervals, it was found that the reaction was slower in starting as time proceeded, and after the fifth day of exposure no more positive results were obtained.

When this stage was reached, the addition of emulsin produced no effect, but after addition of a few drops of amygdalin, a positive reaction was again obtained.

These experiments prove that the enzyme still existed in the plant after drying in air for five days, but that the cyanogenetic glucoside had disappeared.

That the glucoside should have such a short period of existence after the plants are cut and collected, is unfortunate, since the collection of a large quantity of material for the purpose of extraction is thus rendered difficult.

Summary:—The results of these experiments showed:—

(a) That this Alocasia contained a cyanogenetic glucoside and an enzyme.

(b) Glucoside is contained in the leaves, stalks, roots, spathe, ovary, and seeds, but it appeared to be quite absent from the rhizomes, even from those portions of the latter immediately contiguous to the roots. In some of the stalks it appeared to decrease downwards towards the base till the bulbs were reached. These bulbs gave indications of traces only of glucoside.

The part of the plant used by the aborigines as food is the soft pink core of these bulbs or swellings at the base of the stalks, where the latter join the rhizome. The acrid juice is first removed by washing or heating. It is important to note, in this respect, that the suspected poisonous nature of the bulbs does not appear to be due to hydrocyanic acid.

(c) The cyanogenetic glucoside rapidly disappeared from the leaves when they were left to dry in the air for a few days.

(2.) *Alocasia macrorrhiza* var. *variegata* (Nicholson's Dict. of Gardening). This is grown as an ornamental plant in the Botanic Gardens. The leaves are green and white in large patches; some of the leaves showed one half green and the other half white. It was noted in testing these leaves that the green portions always gave rapidly the hydrocyanic acid reaction with the yellow paper, while the white portions showed either negative results, or only a faint colour-change after some time had elapsed. The green stalks also gave rapid positive reactions.

(3.) Another variety of this Alocasia, known as the "black variety," and possessing dark green leaves, with veins and stalks of a dark purple colour, was obtained from the Botanic Gardens. When tested, the leaves and stalks of this plant showed absence of hydrocyanic acid.

(4.) *Alocasia augustiana* Lindl. and Rod., (Nicholson's Dict. of Gardening). This plant resembles (1) but has mottled stalks. It yielded hydrocyanic acid when tested, and the reactions took place rapidly with the leaves, more slowly with the stalks.

(5.) *Alocasia Sanderiana* Bull, (Bailey's Cyclop. of Amer. Hort.). The large arrow-head leaves, with undulating margins and green veins, when tested, gave a red and dark purple colour-change in a few minutes; the mottled stalks also reacted very rapidly.

Two other Alocasias were tested, whose names still await botanical confirmation, but which are apparently well-known to horticulturists:—

(6.) *Alocasia intermedia*, with leaves very similar to (5), but with white veins, and red stalks, gave, with these organs, very rapid and very strong reactions for hydrocyanic acid.

(7.) *Alocasia spectabilis*, whose leaves resemble (1), but with brown under-surface, and white veins, also gave strong and rapid reactions with leaves and stalks.

(8.) *Alocasia metallica* Schott, (syn., *A. indica*, Index Kew.), (Bot. Mag.—description and coloured plate) gave negative results in leaves and stalks.

(9.) *Alocasia zebrina* Koch and Veitch (Index Kew.). The leaves and stalks resemble (4), but contain no cyanogenetic glucoside.

(10.) *Colocasia antiquorum* Schott, (Prodr. Syst. Aroid., 1860, p.138), Index Kew. Cyanogenetic glucosides are absent from the leaves and stalks.

(11.) *Colocasia antiquorum* Schott, var. *esculenta*, Index Kew., the "Taro" cultivated for food in the tropics, was also found to be free from cyanogenetic glucosides. Samples of these plants were obtained from the Botanic and University Gardens, and also from a few private gardens.

Those plants, in which it has just been stated that no cyanogenetic glucoside was found, were afterwards tested by adding a solution of amygdalin to the macerated material. In this way, it was proved that all contained, in their leaves and stalks, an emulsin-like enzyme capable of rapidly hydrolysing amygdalin.

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